Available online at www.sciencedirect.com
SCIENCE DIRECT®
ELSEVIER
Journal of Magnetism and Magnetic Materials 272–276 (2004) 960–961
Journal of magnetism and magnetic materials
www.elsevier.com/locate/jmmm

# Electron spin resonance of the low-dimensional spin-system $Sr_2V_3O_9$

V.A. Ivanshin[a,b,*], V. Yushankhai[b], J. Sichelschmidt[b], D.V. Zakharov[a], E.E. Kaul[b], C. Geibel[b]

[a] *MRS Laboratory, Faculty of Physics, Kazan State University, Kremlevskaya str. 18, 420008 Kazan, Russia*
[b] *Max Planck Institute for Chemical Physics of Solids, Nöthnitzer Str. 40, Dresden 01187, Germany*

**Abstract**

The electron spin resonance (ESR) of the quasi-one dimensional vanadium oxide compound $Sr_2V_3O_9$ has been studied in the temperature range 4.2–500 K. The angular variation and the temperature dependence of the ESR linewidth has been measured in two mutually perpendicular planes of a single crystal. A Dzyaloshinsky–Moriya (DM) interaction with a nonstaggered space distribution of DM vectors is claimed to be responsible for the magnetic properties of this chain-like system.


*PACS:* 75.50.Ee; 75.30.Et; 76.30.−v

*Keywords:* Electron spin resonance; Low dimensionality; Disorder and correlation in quantum systems; Dzyaloshinsky–Moriya interaction

Among many experimental investigation methods of quantum spin chains, electron spin resonance (ESR) is unique for its high sensitivity to anisotropy. The vanadium oxides forming chain structures are of particular importance since they are expected to give new spin systems with pronounced quasi-one dimensional (1D) magnetic properties. Recently, a quasi-1D magnetic behavior was clearly revealed in the chain-like compound $Sr_2V_3O_9$ by means of magnetic susceptibility $\chi(T)$ and the specific heat $C_p(T)$ measurements in polycrystalline samples [1]. The data are compatible with the spin $S = 1/2$ antiferromagnetic (AFM) Heisenberg chain model with nearest neighbor exchange $J \approx 82$ K and much weaker interchain coupling that leads to three-dimensional AFM ordering at the Neel temperature $T_N \approx 5$ K. In addition, an anomalous Curie-like upturn of $\chi(T)$ was found at $T > T_N$ and proposed to be due to intrachain staggered Dzyaloshinsky–Moriya (DM) interaction. In monoclinic $Sr_2V_3O_9$ the structural chains run along the crystallographic $c$-axis and are formed by corner-sharing $VO_6$ octahedra. Neighboring structural chains are connected by $VO_4$ tetrahedra forming VO-layer lying in the $ac$-plane while adjacent VO-layers are separated along $b$-direction by Sr-layers. The alternating tilt of the $VO_6$ octahedra. which form the magnetic chains in $Sr_2V_3O_9$ suggests a staggered character of the DM vector and of the $g$-tensor distribution along magnetic chains. We have carried out the ESR study of the $Sr_2V_3O_9$ single crystals to check this suggestion. $Sr_2V_3O_9$ single crystals were obtained by a traveling solidification zone method. The crystal growth was performed in a vertical tube furnace, using platinum crucibles and a static Argon 6.0 atmosphere. The $Sr_2V_3O_9$ crystals (with typical sizes of about $5 \times 4 \times 2\,mm^3$) were easily cut from the batch. Their orientation and single crystallinity was determined by the Laue method and polarized light. The ESR measurements were performed with a Bruker Elexsys E500 spectrometer at $X$-band frequencies (9.4 GHz). The inset in Fig. 1 represents the temperature

*Corresponding author. MRS Laboratory, Faculty of Physics, Kazan State University, Kremlevskaya str. 18, 420008 Kazan, Russia. Tel.: +7-8432-31-5506; fax: +7-8432-38-7201.
*E-mail address:* vladimir.ivanshin@ksu.ru (V.A. Ivanshin).

0304-8853/$ - see front matter © 2004 Elsevier B.V. All rights reserved.
doi:10.1016/j.jmmm.2003.12.026